LYME DISEASE

a public information
guide from the

Centers for Disease Control

Center for Infectious Diseases

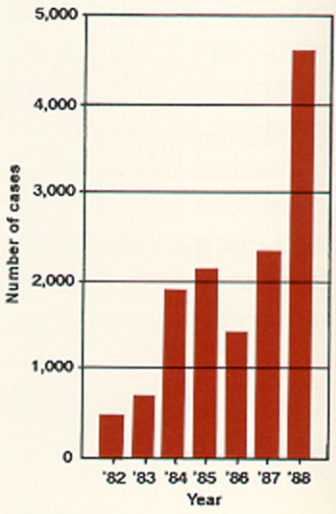
Division of Vector-Borne Infectious Diseases

U.S. DEPARTMENT OF HEALTH
& HUMAN SERVICES
Public Health Service
Centers for Disease Control

CDC

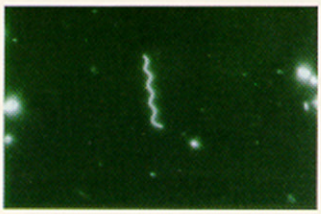
LYME DISEASE

Lyme disease symptoms were recorded in Sweden as long ago as 1908. The disease was first identified in the United States in 1975, after a mysterious outbreak of arthritis among the residents of Lyme, Connecticut. Since then, reports of Lyme disease have increased dramatically, and the disease has emerged as an important national problem.



The causative agent

Lyme disease is caused by a spirochete—that is, a corkscrew-shaped bacterium—named *Borrelia burgdorferi*. This bacterium, identified in 1982 by Dr. Willi Burgdorfer, holds the key to our understanding of the nature of the infection and disease, the nature of the human immune response to the infection, and approaches that can be taken to improve diagnosis and treatment.



Borrelia burgdorferi, ***the corkscrew-shaped bacterium that is the cause of Lyme disease***

Photo by Dr. Alan MacDonald

Tick vectors and transmission to humans

Lyme disease is acquired by the bite of a tick that is infected with the Lyme disease bacterium. The most important tick vectors belong to the genus *Ixodes*. The deer tick, *Ixodes dammini*, which is carried by the white-footed mouse (*Peromyscus leucopus*) and the white-tailed deer (*Odocoileus virginianus*), is responsible for transmitting the bacterium to humans in northeastern and central states. On the Pacific coast, the bacterium is carried by the mouse tick, *Ixodes pacificus*, and in southeastern states by the black-legged tick, *Ixodes scapularis*.

These ticks are much smaller than common dog and cattle ticks. In their nymphal stages, when they most commonly transmit the causative agent to humans, they are no bigger than a pinhead. Adult ticks are only slightly larger.

Photo by Dr. Durland Fish

ticks that transmit Lyme disease are much smaller than common dog and cattle ticks

in their nymphal stages, when they most commonly bite humans, these ticks are no bigger than a pinhead

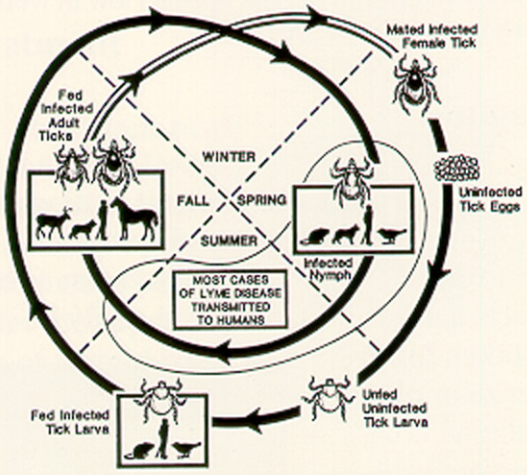
Photo by Bernard Furnival

Life cycle and habitat of vector ticks

Understanding the complex life cycle of the ticks that serve as vectors of Lyme disease is important in planning disease prevention and control approaches:

- Adult ticks feed and mate on large animals, especially deer, in the spring. Female ticks drop off to lay eggs on the ground. After several weeks eggs hatch into larvae.
- Larvae feed on mice in the spring and summer and then hibernate until the next spring when they molt into nymphs.
- Nymphs feed on mice in the summer and molt into adults in the fall, so continuing this two-year life cycle.

CYCLE OF LYME DISEASE



Larvae and nymphs become infected with the Lyme disease bacterium when they feed on infected mice. The bacterium multiplies in the tissues of its tick host. Larvae, nymphs, and adult ticks then bite and infect other mice, other animals, and humans, all in the course of their aggressive feeding behavior.

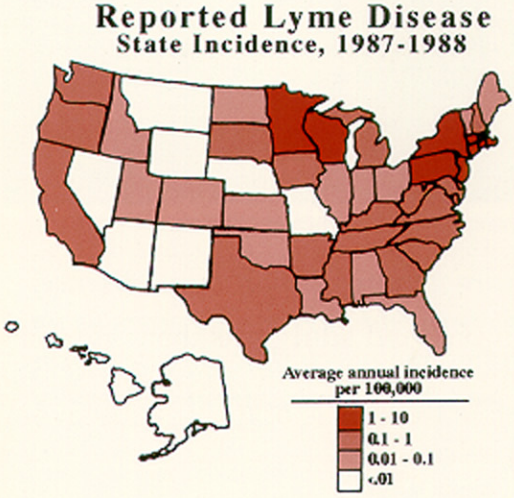
Cats, dogs, horses, and cattle can also become infected with the Lyme disease bacterium, and may develop clinical disease. These animals can carry infected ticks into human habitats, but they cannot transmit the bacterium to humans.

Campers, hikers, outdoor workers, and others who frequent wooded, brushy, and grassy places are most likely to come in contact with ticks. However, because new home development is encroaching more and more on wooded areas, and because the ticks that transmit Lyme disease also flourish in lawns and gardens, especially at the edges of woodlands, the disease has also become a suburban problem.

Geographic distribution

Lyme disease has a nearly worldwide distribution. In the United States, most states have reported cases; the highest incidence occurs in:

- The Northeast, from Massachusetts to Maryland.
- The Midwest, in Wisconsin and Minnesota.
- The West Coast, in California and Oregon.



Clinical signs and symptoms of infection

Lyme disease generally occurs in stages, with different symptoms at each stage. The first stage is usually marked by a flu-like illness and rash:

- fatigue,
- chills and fever,
- headache,
- muscle and joint pain,
- swollen lymph nodes,
- a characteristic skin rash, called erythema migrans, in which one or more red circular patches appear and then expand, often to a large size. Patches vary in shape, depending on their location; frequent sites are on the thigh, groin, trunk, armpits, and on the face in children. The center of the patches may clear as they enlarge, resulting in a ring-like appearance. Patches may be warm, but they usually are not painful.

the characteristic rash of Lyme disease, called erythema migrans, appears as an expanding red patch that may be warm but is not painful

Some clinical signs and symptoms may not appear until weeks or months after a tick bite:

- In some persons the characteristic rash never forms; in some the first and only sign of disease is arthritis, and in others neurologic problems are the only evidence of infection.
- Arthritis may start months or years after a tick bite, and may first appear as intermittent or migratory pain, usually without swelling, and usually in one or several large joints, especially the knees.
- Nervous system abnormalities may be evidenced by numbness, pain, or muscle weakness of the face or limbs, or by stiff neck and severe headache (signs of meningitis).
- Cardiac abnormalities, especially arrhythmias, occur infrequently.
- Lyme disease acquired during pregnancy may lead to infection of the fetus. Fetal infection has been associated with malformations and miscarriages, but the risk appears low in women who are adequately treated.

Diagnosis

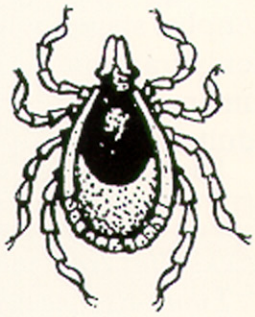
Lyme disease is difficult to diagnose because its clinical signs and symptoms mimic those of many other diseases: fever, muscle aches, and fatigue can easily be mistaken for influenza or other viral infections; joint pain can be mistaken for other types of arthritis; and neurologic signs can mimic those caused by other infections as well.

Photo by John S. Abbott

When considering Lyme disease as a possible diagnosis, physicians evaluate:

- History of possible exposure to ticks, especially ticks in areas known to harbor the Lyme disease bacterium; this includes history of travel to such areas.
- Clinical signs and symptoms.
- Specific laboratory tests—blood tests, and in some cases, cerebrospinal fluid tests—to determine if the patient has antibodies to the Lyme disease bacterium. These tests are most useful at later stages of illness, but even then the tests suffer certain problems of sensitivity and specificity which make interpretation difficult. Better tests are now being developed in several laboratories and should soon help in diagnosis, especially in cases where clinical signs and symptoms do not allow the physician to make a definite diagnosis. As with all laboratory tests, Lyme disease laboratory tests must be standardized and subjected to quality control.

Treatment



Physicians treat patients with Lyme disease with antibiotics; antibiotic usage must always be under the supervision of a physician. Lyme disease patients treated in early stages of the disease, when they only have a rash and flu-like symptoms, usually respond well to therapy and recover rapidly. Patients who are not treated until later in the disease generally respond satisfactorily as well; however, in a small proportion of patients, symptoms may continue or recur, making additional antibiotic treatment necessary. Permanent damage to joints occurs in a small number of patients whose disease is not successfully treated.

Tick control

Although removing deer from tick-infested areas is usually impractical, it has been shown to lower tick density substantially. Clearing and cutting of brush and tall grass around houses and at the edges of gardens may reduce tick density as well. Applying chemical insecticides (acaricides) to suburban woodlands, gardens, and lawns is being done in some areas, but this is rather expensive, and questions remain regarding its effectiveness and environmental safety. In any case, this kind of insecticide application should be supervised by a licensed professional.

Preventing tick bites by personal protection

Chances of tick bite can be lessened with a few precautions:

- Avoid tick-infested areas, especially in May, June, and July (many local health departments and park or extension services have information on the local distribution of ticks).
- Wear light-colored clothing so that ticks can be spotted more easily.
- Tuck pant legs into socks or boots and shirt into pants.
- Tape the area where pants and socks meet so that ticks cannot crawl under clothing.

Photo by Pfizer Incorporated

- Spray insect repellent containing DEET or permethrin on pants, socks, and shoes.
- Wear a hat and a long-sleeved shirt for added protection.
- Walk in the center of trails to avoid overhanging grass and brush.
- After being outdoors, remove, wash, and dry clothing at a high temperature; inspect body carefully and remove attached ticks with forceps or tweezers, grasping the tick as close to the skin surface as possible and pulling straight back with a steady force; avoid crushing the tick's body. In some areas, ticks (saved in a sealed container) can be submitted to the local health department for identification.

Lyme disease research continues

Scientists are working to find out:

- Which chemicals and other approaches are best for controlling ticks in each kind of habitat.
- Where infected ticks are most likely to be and how best to avoid them.
- Whether an effective vaccine can be developed.
- If antibiotic treatment can be used to prevent infection after a tick bite occurs.
- How to further improve diagnostic methods.
- How the Lyme disease bacterium causes chronic infections of the joints and nervous system, and how to prevent these complications.

For further information, contact your physician or your local health department.

Cover photo by Bernard Furnival